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To: Cynthia K. Lee, Examiner

Firm: Commissioner for Patents

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Comments:

Application of	
Applicants	: O'Hara et al.
Serial No.	: 10/628,316
Filed	: July 28, 2003
Title:	: **DIFFUSION MEDIA TAILORED TO ACCOUNT FOR VARIATIONS IN OPERATING HUMIDITY AND DEVICES INCORPORATING THE SAME**
Docket No.	: GMC 0048 PA/GP-303569/40320.53
Examiner	: Cynthia K. Lee
Art Unit	: 1745
Conf. No.	: 4452

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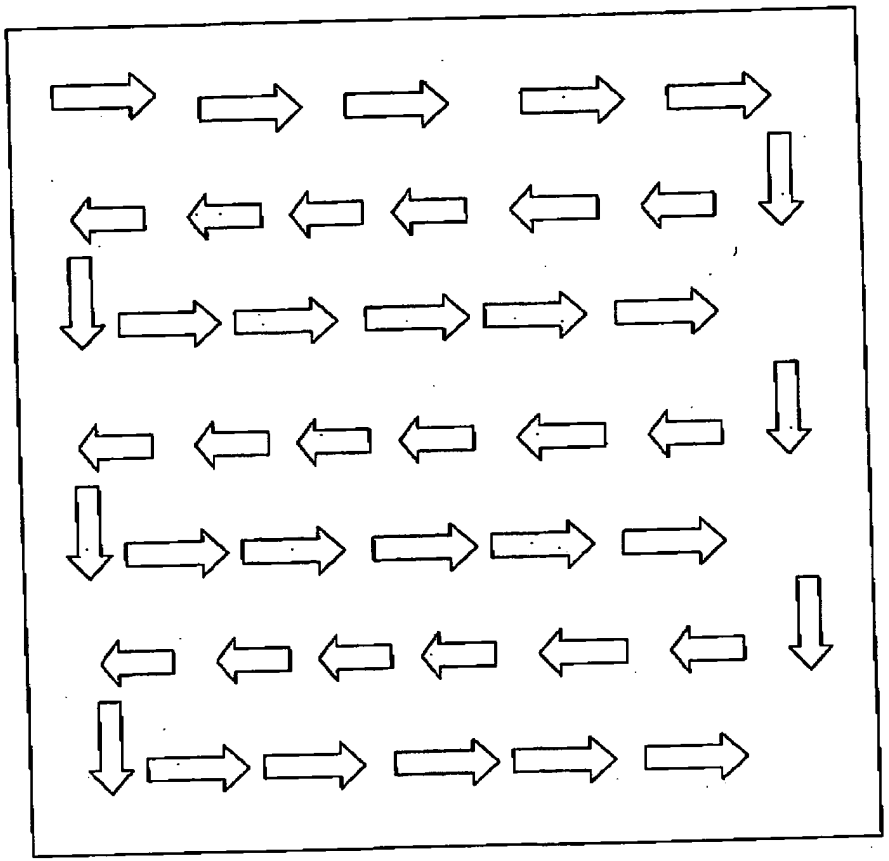
1) How is this saturated RH achieved inside the fuel cell, and how is the diffusion media tailored to operate under these conditions? Inlet gases are going in fully humidified, ie the gases are holding all the water vapor they can at that T. Anything over this would be considered oversaturated, thus the product water being made on the cathode is considered as over saturating the stream, leading to our nomenclature of >100%RH, which basically means there is liquid water coming out the exit stream.

Inlet

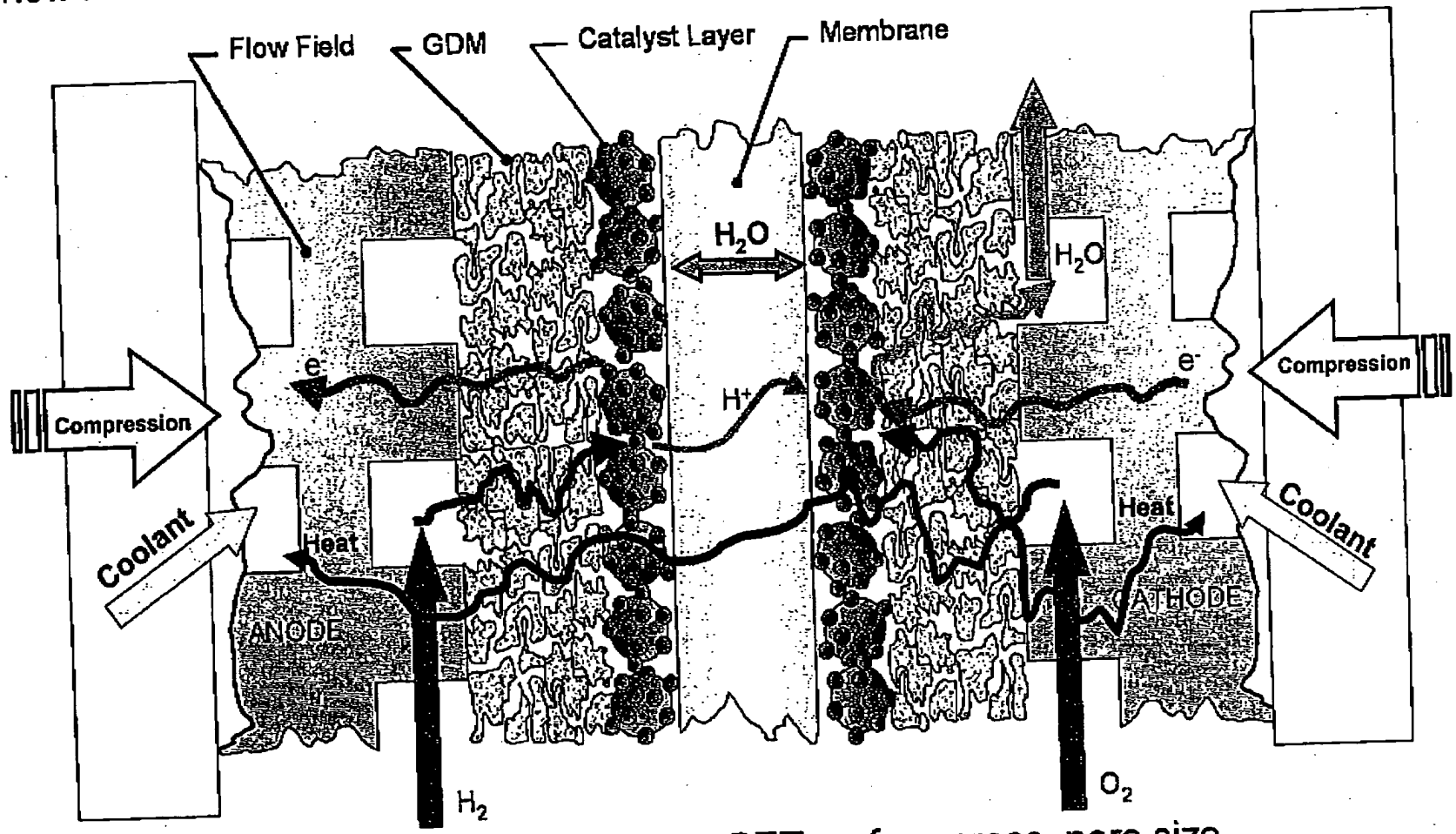


O_2 is being consumed along gas flow channel length; inlet humidification is preserved and water is being produced, leading to oversaturation at outlet (100%RH + liq water)

Outlet

$$O_2 + 2H_2 \rightarrow 2H_2O$$

how is the diffusion media tailored to operate under these conditions



-Carbon blacks have different porosities, BET surface areas, pore size distributions. As the water is transported away from the MEA, these carbon properties handle water differently; as the RH increases past saturation (liq water present), it becomes more difficult to balance electrode flooding and gas transport limitations.

2) How are all the calculations performed in the spreadsheet?

Inputs

Press	T_cell	T_an	T_cath
kPa	C	C	C
100	80	80	80
st_H2	st_O2	y_CO2_dry	y_N2_dry
-	-	-	-
2	2	0	0.79

These are inputs based on operating conditions: pressure, stoichiometry of gases, cell temperature and saturator temps of anode and cathode.

Intermediate values

Psat	TK	RH_an	RH_cath
kPa	K	-	-
47.35	353.15	1.00	1.00

RH of anode and cathode; values are 1 because both saturators are at 80C, the dewpoint, so RH is 100%--the gases are going in fully saturated.

T converted to K

Vapor pressure of water at 80C (taken from CRC Handbook of Chemistry and Physics)

Mole fractions

Species	Inlet fuel	Inlet air	Outlet fuel	Outlet air
H2	0.526	-	0.426	-
CO2	0.000	-	0.000	-
H2O	0.474	0.474	0.574	0.574
O2	-	0.111	-	0.050
N2	-	0.416	-	0.376
Sum	1	1	1	

If there is 1 mole of gas, .526 mol is hydrogen and 0.474 mol is water vapor based on the vapor pressure of water at 80C (slide 2).

If there is 1 mole of gas, .111 mol is oxygen (0.21*(1-.474)) and 0.474 mol is water vapor based on the vapor pressure of water at 80C (slide 2).

Mass balance shows that as fuel is being consumed, the molar fraction of H2 is reduced.

Again, oxygen is being consumed, water is being produced, so the molar fraction of water increases.

Results
RH_exit
-
1.212

=(molar fraction of water at outlet *total pressure)/total amount of water vapor pressure the gas can hold at that T (from CRC- 47.4kpa). Since there is more water and less gas, there is liquid water present. The fuel cell isn't operating steady state at this RH, but it reflects a relative value to compare operating conditions.